

(C//NF) Network Operations Division Cryptographic Requirements

(U//FOUO) NOD Specification 001: Version 1.1



Classified By: 2343997

Derived From: CIA NSCG COM S-06, CIA NSCG EQU S-06, CIA NSCG MET C-06, CIA NSCG MET S-06

Reason: 1.4(c)

Declassify On: 25X1, 20630204

1 (U) Table of Contents

2	(U) Requirements	3
2.1	(U) Overview	3
2.2	(U) Terminology	3
2.3	(U) Changelog.....	5
2.4	(C//NF) Tools with initial delivery 1 January 2012 or later	5
2.5	(C//NF) Tools with initial delivery prior to 1 January 2012.....	8
3	(C//NF) The Long-lived Suite for Network Communication.....	9
4	(C//NF) The Short-lived Suite for Network Communication.....	10
5	(C//NF) The Weak Suite for Network Communication	11
6	(C//NF) The Collection Encryption Suite	12
7	(C//NF) The Tool State Encryption Suite	13
8	(U) Commentary	14

2 (U) Requirements

2.1 (U) Overview

1. (U//FOUO) Redacted.
2. (U//FOUO) Cryptographic jargon is utilized throughout this document. This jargon has precise and subtle meaning and should not be interpreted without careful understanding of the subject matter. Suggested reading includes *Practical Cryptography* by Schneier and Ferguson, RFCs 4251 and 4253, RFCs 5246 and 5430, and *Handbook of Applied Cryptography* by Menezes, van Oorschot, and Vanstone. Special mention must be made of NIST SP 800-57-1 (draft May 2011 or later), which is a very thorough explanation of cryptosystem design details, and its excellent discussion on security strength (generally half the shortest key length) and their expected lifetimes in Section 5.6. Further references are noted in the commentary section.
3. (U//FOUO) These requirements bear intentional similarity to the National Security Agency's Suite B of Cryptographic Algorithms as well as industry best practice.
4. (C//NF) These requirements are intended to ensure a satisfactory minimum level of security for tools used to advance the CIA's intelligence collection activities. Because not every idea can be foreseen authors with particularly novel or creative ideas are encouraged to contact the IOC Operational Cryptography Review Board (OCRB) for discussion if it appears the idea cannot be made to comply with these requirements.
5. (C//NF) A tool satisfying all requirements of this document may be described as "Compliant with the Network Operations Division Cryptographic Requirements version X" where X is the version number listed on the title page of this document.
6. (C//NF) This document intentionally refers to non-embedded device software only.

2.2 (U) Terminology

1. (U) MUST – This word, or the term "SHALL", means that the definition is an unconditional requirement of this specification.
2. (U) MUST NOT – This phrase, or the phrase "SHALL NOT", means that the definition is an unconditional prohibition of the specification.
3. (C//NF) SHOULD – This word, or the adjective "RECOMMENDED", means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be

understood and carefully weighed before choosing a different course. The recommendations of this document outline options for increased security above and beyond the bare essential. The choices made in these items will be prime criteria for evaluation against competing solutions. Given CIA's hostile operating environment it is expected that more secure solutions will generally be preferred.

4. (C//NF) SHOULD NOT – This phrase, or the phrase “NOT RECOMMENDED” mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label. The recommendations of this document outline options for increased security above and beyond the bare essential. The choices made in these items will be prime criteria for evaluation against competing solutions. Given CIA's hostile operating environment it is expected that more secure solutions will generally be preferred.
5. (U) MAY – This word, or the adjective “OPTIONAL”, means that an item is truly optional.
6. (C//NF) TARGET – This word is used in reference to a deployed tool or implant executing on an untrusted or hostile device and communicating over an untrusted or hostile network. This word may also be used to refer to the untrusted or hostile device itself. CIA personnel will not have physical access to or control of items on the target.
7. (S//NF) SERVER – This word is used in reference to CIA controlled infrastructure or personnel. This word does not refer to intermediate nodes used for the purposes of redirection. CIA control does not indicate the absence of hostile implantation or exploitation; most server components will be exposed to hostile network connections and exploitation attempts and may be executing on hardware not under immediate CIA supervision. Designs incorporating defense in depth are **recommended**.
8. (S//NF) TRANSPORT – This word means the overt communication protocol being exercised between the target and the server as a cover for action. For example, HTTPS, SMTP, IMAP, Jabber, Windows Error Reporting, Skype.
9. (S//NF) TRANSPORT ENCRYPTION – This phrase refers to the native encryption available for a transport where the use of that encryption with the transport protocol would be considered innocuous by the average observer (e.g., SSL/TLS for HTTPS, Encrypted Skype chat, SSL/TLS for secure Jabber, Encrypted RDP). This explicitly does not refer to any inner cryptostream compliant with the encryption suites as defined below.
10. (C//NF) BLENDING – This word means the actions taken by the transport to assure passive or active observers of the benign nature of the communication, concealing its true purpose.
11. (C//NF) TAKE – This word refers to all data collected from a target in the course of a CIA clandestine operation. All take is considered raw intelligence until assessed otherwise and maximum care must be taken to preserve it.

2.3 (U) Changelog

1. (U) Version 1.0 to 1.1

- a. (U//FOUO) Redacted.
- b. (U) 2.1: Created Overview section from bullets originally present in Terminology and section 2.4.
- c. (C//NF) 2.2.11: Added "TAKE" to Terminology
- d. (C//NF) 2.4.15: Added PKCS #5 as a synonym for ANSI X.923 symmetric padding.
- e. (S//NF) 3.7, 4.7, 5.8: No longer discourage use of CBC mode. Though slightly inferior to other modes of operation it is widely available in standard APIs and encourages their use.
- f. (U//FOUO) Redacted.
- g. (U//FOUO) Added Portion marking.
- h. (S//NF) 2.2.6: Clarify the definition of "TARGET" to include interchangeable use of an implant and the computer hosting the implant.
- i. (C//NF) 2.4.19: Clarify that any use of transport encryption is layered over the encryption specified in this document.
- j. (S//NF) 2.1.6: Clarify this document does not refer to embedded devices or hardware implants.
- k. (U//FOUO) 8.i: Clarify some reasons asymmetric cryptography is so pervasive in this document.
- l. (U//FOUO) 2.4.16: Prohibit the use of PKCS #1v1.5 asymmetric padding.
- m. (U//FOUO) 3.1, 4.1, 5.1: Clarify that Diffie-Hellman and RSA must have larger keys than ECDH.
- n. (U//FOUO) 3.1, 4.1, 5.1: Clarify that Diffie-Hellman alone does not provide perfect forward secrecy.
- o. (U//FOUO) 2.1.7: Added bullet clarifying the nature of the classification of this document and acceptable means to lower the classification.

2.4 (C//NF) Tools with initial delivery 1 January 2012 or later

1. (S//NF) All tools utilizing network communication **must** implement either the Long-lived, Short-lived, or Collection Encryption Suite of cryptographic algorithms as defined below. A tool's author **must** implement the appropriate suite for the tool's Concept of Operation (CONOP).ⁱ
2. (S//NF) All tools **should** implement the Tool State Encryption Suite in reference to configurable state (e.g., callback addresses, intervals, subsequent persistent cryptographic keys). Tool authors **may** extend the implementation of the Tool State Encryption Suite to tool components (e.g., code blocks, packaged components within an installer) but **must** carefully consider and evaluate the impact on PSP performance.
3. (S//NF) All cached or otherwise stored take which has not yet been transferred to server and is not stored in RAM **should** be protected using the Collection Encryption Suite.
4. (S//NF) Communications involving only file exchange (e.g., an automated implant collecting tasking or submitting tasking results) **must** encrypt the exchanged file using the Collection Encryption Suite. This encryption **must** be separate from and additional to any transport encryption. Such communications **may** incorporate either the Long-lived or Short-lived Suites.
5. (S//NF) All tools **must** utilize Operating System (OS) provided cryptographic primitives where available (e.g., Microsoft CryptoAPI-NG, OpenSSL, PolarSSL, GnuTLS, etc). Note the guidance in the relevant encryption suites regarding suitable Certificate Authorities (CAs) for each phase of communication. Deviations **must** be justified and accepted by the OCRB.ⁱⁱ
6. (S//NF) All tools **must** utilize OS provided cryptographically *secure* sources of entropy (e.g., /dev/random on *nix, Microsoft CryptoAPI, etc) and **should** be a source compliant with NIST SP 800-90. If a non-800-90 mechanism is used, the output from the source of entropy **must** be hashed with SHA-256 prior to use. Deviations from this **must** be justified and accepted by the OCRB.ⁱⁱⁱ
7. (S//NF) All message digests **must** be performed using SHA-256, SHA-384, or SHA-512 without truncation. HMACs **must** be performed using HMAC-SHA256, HMAC-SHA384, or HMAC-SHA512 without truncation.^{iv} Digests and HMACs **must** be computed over the ciphertext (to include Initialization Vectors) of each message vice the plaintext.^v
8. (U) Asymmetric cryptography **must not** be used directly for bulk encryption. It **must** only be used to negotiate or exchange secrets used for symmetric encryption and for digital signatures and their verification.^{vi}
9. (S//NF) Communication adhering to these requirements involves multiple cryptographic keys, whether used for encryption, authentication, or integrity checking. All entropy used for key material (including components of key exchange) **must** be generated using a source of randomness as defined in 6 above. Keys **should** be generated independently where possible but **may** be derived from an exchanged secret using Key Derivation Functions (KDFs) approved by NIST SP 800-108

(October 2009) and NIST SP 800-56C (second draft July 2011) or later revisions.^{vii} If such a KDF is chosen then the exchanged secret **must** have a length equal to sum of the lengths for all needed key material (e.g., 512 bits if two 256 bit keys are required).^{viii} The guidance regarding hashing algorithm selection in 7 above applies to the hashing algorithms chosen for use with the KDF.

10. (S//NF) Messages **should** be compressed prior to encryption.^{ix} Compression **must** be performed using appropriate domain-specific compression (e.g., MP3 for audio, BZIP2, GZIP, ZLIB, or raw DEFLATE for arbitrary data).^x Compression **should** be performed using OS provided APIs.^{xi} Authority to determine whether a compression routine is considered appropriate for a domain rests with the OCRB.
11. (S//NF) For pseudo One Time Pad ciphers and block modes (i.e., RC4, CTR, GCM), all communication from target to server **must** use distinct encryption keys from those used for server to target.^{xii}
12. (S//NF) Tools **should** perform key exchange exactly once per connection. Many algorithms have weaknesses during key exchange and the volume of data expected during a given connection does not meet the threshold where a re-key is required.^{xiii} To reiterate, re-keying is **not recommended**.
13. (S//NF) To guard against replay attacks every message sent **must** employ a nonce scheme. Nonces **should** take the form of monotonic message numbers and, if so, **must** track message numbers from each party separately. Alternatively, nonce schemes **may** use a timestamp easily converted to a full UTC date and time but due to the difficulty in ensuring close time synchronization when messages are frequent, timestamps are **not recommended**. Nonce values **must not** be repeated for the same encryption key and authentication key combination.
14. (S//NF) For CBC mode all Initialization Vectors (IVs) **must** be strong pseudorandomly generated, randomly generated as in 6 above, or generated using a KDF as permitted in 9 above.^{xiv} For CTR and GCM mode, all IVs **should** start from zero and **should** use strong pseudorandom or random fixed field prefix padding to bring the counter value up to the minimum length.^{xv} All IVs **must** have a minimum length of one block of the chosen cipher.^{xvi} IVs **must not** be reused with the same encryption key.^{xvii}
15. (S//NF) Padding for symmetric encryption, when required by the chosen cipher and mode, **must** be performed using either the PKCS #7 or ANSI X.923/PKCS #5 padding techniques.^{xviii} Padding **must** be applied after any compression but before any encryption.
16. (S//NF) Padding for asymmetric encryption, when required, **must not** be performed using the PKCS #1v1.5 padding scheme^{xix}. OAEP padding is **recommended**.
17. (C//NF) Proper key management **must** be carefully considered by tool authors to ensure that each deployed tool utilizes unique persistent keys (including unique server keys where appropriate). Authors **must** submit a key management plan outlining the mechanisms used to ensure uniqueness properties, proper usage, and archiving of all keys on a classified CIA network.

18. (C//NF) Tool authors **must** submit a cryptographic design document for approval to the OCRB. This document **must** contain sufficient information regarding the tools use and handling of the concepts discussed in these requirements to convince them that the design is secure. Specifically, this document **must** discuss key management (authors **may** reference their key management plan), IV selection, algorithm selection, message format (as it pertains to the cryptographic details), frequency of messages, error/failure handling, authentication, key exchange, integrity assurances, and similar details. Authors **should** expect that this design will be reviewed by other entities within the US Government (e.g., the NSA) while respecting Proprietary Information controls. Submission of this document early in the development cycle is **recommended**. A cryptographic design approval is valid for a single tool and remains valid until and unless authors undertake substantive changes in the use of cryptography or until the approval is revoked.
19. (S//NF) These cryptographic suites are intended to protect the innermost layer of communication. It is expected and encouraged that transport protocol standards will additionally encrypt traffic exchanged via that transport as appropriate (e.g., HTTP over TCP port 80 should not be overtly encrypted but HTTPS over TCP port 443 should be). Any transport layer encryption **must** be layered over the cryptography discussed in this document. Because this outer layer may be decrypted by an attacker (e.g., SSL Man-in-the-Middle) any transport encryption **must** be used for traffic blending only and not for secrecy.^{xx}
20. (C//NF) The IOC Operational Cryptography Review Board (OCRB) **must** approve all deviations from these requirements.

2.5 (C//NF) Tools with initial delivery prior to 1 January 2012

1. (U//FOUO) Existing tools **must** implement all requirements for new tools as above.
2. (C//NF) Optionally, existing tools **may** implement the Weak Suite instead of the Long-lived or Short-lived Suite of cryptographic algorithms as defined below. Tools which utilize the Weak Suite **should** plan to become compliant with either the Long-lived or Short-lived Suites.
3. (U//FOUO) Approval of cryptographic design and key management plan is **recommended** but not mandatory.

3 (C//NF) The Long-lived Suite for Network Communication

(S//NF) The Long-lived Suite of algorithms is intended for use with tools residing on a target or redirector for longer than one working day but **may** be used by tools with shorter expected lifetimes. In general the structure of the Long-lived Suite is similar to that of a TLS 1.2 handshake with client authentication, specifically in the use of asymmetric cryptography to provide authentication and key exchange followed by communication utilizing symmetric cryptographic primitives together with the exchanged secrets to provide confidentiality and integrity. The inclusion of TLS 1.2 in this suite does not imply that a protocol adhering to this suite may be described as “SSL” or “HTTPS”.

1. (S//NF) Key exchange **must** be performed using Diffie-Hellman, Elliptic Curve Diffie-Hellman, or RSA. For Elliptic Curve Diffie-Hellman the prime moduli utilized **must** be at least 256 bits. For Diffie-Hellman and RSA the primes utilized **must** be at least 2048 bits. The use of Diffie-Hellman or Elliptic Curve Diffie-Hellman is **recommended** to allow for perfect forward secrecy.
2. (S//NF) Authentication **must** be performed using TLS 1.2, Elliptic Curve DSA, DSA, or RSA. Asymmetric keys **must** be at least 2048 bits (256 bits for elliptic curve prime moduli).
3. (S//NF) Authentication via TLS 1.2 **must** include the use of certificates by both parties.
4. (S//NF) Authentication via TLS 1.2 **must** validate that the certificate utilized by both parties match preshared certificates or a preshared CA. Should validation of either party fail, the other **should** terminate the connection but the termination decision **may** rest with the server component alone. Certificate validation **must not** be performed against any standard SSL root CAs. Note that this guidance refers to the *inner* cryptostream which may optionally be masked by HTTPS (or some other outer transport protocol), this does not refer to the certificates or encryption used by the *outer* blending channel.
5. (S//NF) Tools **must** support the use of unique certificates and CAs for network authentication for each deployment or group of deployments (e.g., through Server Name Identification (SNI) extension for TLS).
6. (S//NF) Integrity **must** be provided using HMAC with a key size of at least 256 bits.
7. (S//NF) Confidentiality **must** be provided by AES with a minimum key size of 256 bits. The cipher **must** be operated in Galois/Counter Mode (GCM), Counter Mode (CTR), or Cipher Block Chaining Mode (CBC).

4 (C//NF) The Short-lived Suite for Network Communication

(S//NF) The Short-lived Suite of algorithms is intended for use with tools residing on a target or redirector for less than one working day. Asymmetric cryptography is utilized to a lesser degree by the Short-lived Suite because the CONOP for the suite implies a far greater control of the tool by an operator and a lower risk of exposure to hostile actors.

1. (S//NF) Key exchange **must** be performed using Diffie-Hellman, Elliptic Curve Diffie-Hellman, or RSA. For Elliptic Curve Diffie-Hellman the prime moduli utilized **must** be at least 256 bits. For Diffie-Hellman and RSA the primes utilized must be at least 2048 bits. The use of Diffie-Hellman or Elliptic Curve Diffie-Hellman is **recommended** to allow for perfect forward secrecy.
2. (S//NF) Authentication **must** be provided using HMAC, asymmetric cryptography, or by operating the chosen block cipher in Galois/Counter Mode (GCM).
3. (S//NF) Authentication using HMAC **must** use a key size of at least 256 bits. The key **must** be preshared and **must not** be reused for any other deployment.
4. (S//NF) Authentication using asymmetric cryptography **must** be provided using TLS 1.2, Elliptic Curve DSA, DSA, or RSA using asymmetric keys of at least 2048 bits (256 bits for elliptic curve prime moduli). All authentication based on certificates and CAs **must** follow the requirements concerning certificates and CAs described in the Long-lived Suite paragraphs 4, and 5.
5. (S//NF) Integrity **must** be provided using HMAC with a key size of at least 256 bits.
6. (S//NF) Authentication and Integrity HMACs **may** be one and the same if HMAC is used for authentication.
7. (S//NF) Confidentiality **must** be provided by AES with a minimum key size of 256 bits. The cipher **must** be operated in Galois/Counter Mode (GCM), Counter Mode (CTR), or Cipher Block Chaining Mode (CBC).

5 (C//NF) The Weak Suite for Network Communication

(S//NF) The Weak Suite is intended as a transition suite and **must not** be used for new tools. As the name implies, it provides reduced security compared to the other suites. Tools utilizing this suite **should** plan to transition to either the Long-lived or Short-lived Suites to facilitate deliveries once the Weak Suite has been retired. The Weak Suite **shall** be retired on 31 December 2013 and **shall not** be used for deliveries after that time. This date complies with NIST Special Publication 800-131A regarding protection of unclassified data for US Government systems.

1. (S//NF) Key exchange **must** be performed using Diffie-Hellman, Elliptic Curve Diffie-Hellman, or RSA. For Elliptic Curve Diffie-Hellman the prime moduli utilized **must** be at least 128 bits. For Diffie-Hellman and RSA the primes utilized must be at least 1024 bits. The use of Diffie-Hellman or Elliptic Curve Diffie-Hellman is **recommended** to allow for perfect forward secrecy.
2. (S//NF) Authentication **must** be provided using HMAC, asymmetric cryptography, or by operating the chosen block cipher in Galois/Counter Mode (GCM).
3. (S//NF) Authentication using HMAC (which **may** include HMAC-SHA1) **must** use a key size of at least 128 bits. The key **must** be preshared and **must not** be reused for any other deployment.
4. (S//NF) Authentication using asymmetric cryptography **must** be provided using TLS 1.2, Elliptic Curve DSA, DSA, or RSA with asymmetric keys of at least 1024 bits (128 bits for elliptic curve prime moduli). All certificate and CA handling instructions and requirements from the Long-lived Suite **must** also be applied.
5. (S//NF) Authentication using GCM mode **must** use a tag length of 128. The author **must** carefully consider NIST SP 800-38D (November 2007), especially the peculiarities described in Appendixes A and B.
6. (S//NF) Integrity **must** be provided using HMAC (which **may** include HMAC-SHA1) with a key size of at least 128 bits. Alternatively, integrity **may** be provided by using Elliptic Curve DSA, DSA, or RSA signatures on message digests. The certificates used to generate these signatures **must** either be preshared or utilize a preshared CA and **must** have a key size of at least 1024 bits (128 bits for elliptic curve prime moduli).
7. (S//NF) Authentication and Integrity HMACs **may** be one and the same if HMAC is chosen for both.
8. (S//NF) Confidentiality **must** be provided by AES, Serpent, Twofish, Blowfish, 3DES, or RC4 with a minimum key size of 128 bits. Block ciphers **must** be operated in Galois/Counter Mode (GCM), Counter Mode (CTR), or Cipher Block Chaining Mode (CBC). If RC4 is used, at least the first 1024

bytes of the cryptostream **must** be discarded and may not be used.^{xxi} AES is **recommended** due to hardware implementations by major CPU vendors and to enable transition to a more secure suite.

9. (U//FOUO) Redacted.

6 (C//NF) The Collection Encryption Suite

(S//NF) The Collection Encryption Suite is intended to safeguard collected information as it resides temporarily on an untrusted file system or as it transits a file-oriented communication mechanism (e.g., gap jumpers, bit torrent, HTTP post, etc.). This suite is primarily intended for Automated Implants, Autonomous Implants, and collection tools but **may** be applied by other tools utilizing file-oriented transports. Note that the Collection Encryption Suite is intended for files generated by a tool for transfer to server and for tasking from server to target, for encryption of data referenced repeatedly by a tool utilize the Tool State Encryption Suite. Like the Long-lived Suite this also resembles TLS 1.2 except that the Collection Encryption Suite protects a communication in time rather than an interactive communication.

1. (S//NF) Authentication and Integrity **must** be provided by a signed message digest. The message digest **must** be calculated over the encrypted file. The results of the calculated message digest **must** then be signed using the sender's preshared asymmetric private key and attached to the encrypted blob (e.g., appended, prepended, etc).
2. (S//NF) Confidentiality **must** be provided by AES with a key size of at least 256 bits. The cipher **must** be operated in Galois/Counter Mode (GCM), Counter Mode (CTR), or Cipher Block Chaining Mode (CBC).
3. (S//NF) For each transmission the encrypting session key **shall** be generated randomly by the sender and used to encrypt the file. The session key **shall** then be encrypted to the recipient's preshared asymmetric public key and attached to the encrypted blob (e.g., appended, prepended, etc).
4. (S//NF) All asymmetric keys used in this suite **must** have a length of at least 2048 bits (256 bits for elliptic curve prime moduli).^{xxii}

7 (C//NF) The Tool State Encryption Suite

(S//NF) The Tool State Encryption Suite is intended to safeguard tool components, state, and working data that is unsuited for or not ready to be transferred to the server as it resides on an untrusted file system or other persistent storage.

1. (S//NF) Integrity **must** be provided by HMAC with a key size of at least 256 bits.
2. (S//NF) Confidentiality **must** be provided by AES with a key size of at least 256 bits. The cipher **must** be operated in Galois/Counter Mode (GCM), Counter Mode (CTR), or Cipher Block Chaining Mode (CBC).
3. (S//NF) Optionally a tool **may** verify a digital signature on a message digest calculated over the encrypted form of the relevant state. The signing private key for this purpose **must** only exist on a CIA classified network and **must** have a length of at least 2048 bits (256 bits for elliptic curve prime moduli) while the relevant public key **shall** be stored on the target. Consequently this additional authentication can only verify certain static or default components or states.
4. (S//NF) There is additional risk to the stored data because of the need for the target component of the tool to decrypt the stored state. Consequently tool authors **should** carefully consider key management on the target, this **must** include any authentication and integrity keys in addition to the encryption key.^{xxiii}

8 (U) Commentary

ⁱ (S//NF) In particular, asymmetric cryptography is heavily use to limit the utility of previously captured network transmissions by preventing decryption even after reverse engineering the implant and to minimize the data encrypted with any particular key material to limit SIGINT cryptanalysis.

ⁱⁱ (S//NF) In particular, the justification that an attacker might hook the OS provided cryptographic API to perform reverse engineering of the implant is not acceptable; any service (including execution) provided by the OS may be subverted and the security of a proven library outweighs the risk of attack.

(U//FOUO) A special note for tools targeting versions of Microsoft Windows prior to Vista: the Microsoft CryptoAPI (as distinct from the Microsoft CryptoAPI-NG) does not offer all the cryptographic primitives required by this document. Specifically the Microsoft Enhanced Cryptographic Provider does not provide the message digest algorithms required in 7. These algorithms were added in the Microsoft Enhanced RSA and AES Cryptographic Provider (Prototype) bundled with Windows XP SP3. This module, renamed Microsoft AES Cryptographic Provider, is also available as an optional hotfix for Windows 2003. Tools which must support Windows 2003 or Windows XP SP2 and below **should** statically link an implementation of the necessary primitives from OpenSSL or similar library but **may** implement these primitives.

ⁱⁱⁱ (U) Insecure sources of entropy can lead to unacceptably poor quality cryptographic keys and therefore total cryptosystem compromise.

NIST Special Publication 800-90: Recommendation for Random Number Generation Using Deterministic Random Bit Generators (Revised March 2007). http://csrc.nist.gov/publications/nistpubs/800-90/SP800-90revised_March2007.pdf

^{iv}(U) The use of SHA-1 has been deprecated for digital signature purposes after December 31, 2010. Though other uses remain acceptable we have chosen to eliminate its use entirely in the interests of simplicity of implementation by not introducing multiple hash mechanisms within a project and for ease of assuring the desired security level.

NIST Special Publication 800-131A: Transitions: Recommendation for Transitioning the Use of Cryptographic Algorithms and Key Lengths (January 2011).
<http://csrc.nist.gov/publications/nistpubs/800-131A/sp800-131A.pdf>

^v (U//FOUO) The digest is calculated over the ciphertext vice plaintext in order to protect against a SIGINT actor with access to a compromised host obtaining any information about the transfer. Using the example of an exfiltrated file (and depending on communication protocols) it is possible that a SIGINT actor could compare the hash value of every file on the compromised host to the intercepted message and thereby determine which file was exfiltrated. Calculating the digest over the ciphertext eliminates this possible information leakage without altering difficulty of implementation. See also the various

debates about Encrypt-and-MAC, MAC-then-Encrypt, and Encrypt-then-MAC. The IV is authenticated by the digest in order to prevent a manipulated IV from flipping bits in the first block of the plaintext upon decryption under certain modes.

^{vi} (U) Asymmetric cryptography is significantly more computationally expensive than symmetric. Additionally, limiting the use of asymmetric keys in this way also reduces the amount of data encrypted with any given key and consequently makes cryptanalysis much more difficult. Menezes, van Oorschot, and Vanstone. Handbook of Applied Cryptography (August 2001). Chapter 12.

^{vii} (U) Independent generation of keys provides the maximum protection from related key attacks and implementation errors. It is, however, more difficult to implement and more wasteful of entropy and require more network messages than the use of a KDF. NIST Special Publication 800-108: Recommendation for Key Derivation Using Pseudorandom Functions (Revised October 2009) <http://csrc.nist.gov/publications/nistpubs/800-108/sp800-108.pdf>

^{viii} (U) This maximizes entropy in the derived keys. NIST Special Publication 800-108: Recommendation for Key Derivation Using Pseudorandom Functions (Revised October 2009) Section 7.3. <http://csrc.nist.gov/publications/nistpubs/800-108/sp800-108.pdf>

^{ix} (U) Compression reduces the amount of information to be encrypted, thereby decreasing the amount of material available for cryptanalysis. Additionally, compression is designed to eliminate redundancies in the message, further complicating cryptanalysis.

^x (U) Domain specific compression is utilized to maximize compression ratio.

^{xi} (S//NF) OS provided compression routines are recommended to ensure correctness without an increase in code size.

^{xii} (U) As a property of the way these cryptographic algorithms are implemented an adversary can XOR two ciphertexts encrypted with the same key in order to obtain the XOR of the two plaintexts, thereby destroying most or all confidentiality.

^{xiii} (S//NF) The exact nature of which algorithms are weak at this stage is highly classified. In the absence of those facts this guidance is still relevant; the utility inherent in re-keying derives from minimizing key exposure when performing bulk encryption of large amounts of data. Even the most data-intensive NOD operations involve several fewer orders of magnitude of data per session key. Consequently, re-keying introduces unnecessary complexity (and therefore opportunities for bugs or other unexpected behavior) without delivering value in return.

^{xiv} (U) This avoids a number of attacks inherent in CBC. The key property to these attacks is that the IV be unpredictable and, in the interests of not exhausting the target's entropy pool we permit pseudorandom

generation of this value.

Security of CBC Ciphersuites in SSL/TLS: Problems and Countermeasures. 2004-05-20.

<http://www.openssl.org/~bodo/tls-cbc.txt>

^{xv} (S//NF) The additional entropy from the tag prefix is used as a simple to implement mechanism to make IV/session key collisions even rarer than $1/2^{256}$. Though selecting an initial counter value randomly also increases the odds of a collision it also introduces difficulties in exchanging initial value and determining whether a counter sequence under the same key will overlap with a different counter sequence.

^{xvi} (U) This substantially increases the difficulty of pre-computing the IV, thereby protecting against certain chosen plaintext attacks.

^{xvii} (U) Reusing IVs under the same encryption key significantly reduces, and for some modes destroys, confidentiality.

^{xviii} (U) These techniques are simple to implement and ensure no confusion about padding values versus message values.

^{xix} (U) Bleichenbacher, Chosen Ciphertext Attacks against Protocols Based on the RSA Encryption Standard PKCS #1, 1998

Bleichenbacher, Kaliski, and Staddon, Recent results on PKCS #1: RSA Encryption Standard, 1998.

^{xx} (S//NF) To reiterate using an example: An implant named X communicates using files sent over HTTPS GETs and POSTs. To be compliant with this document, X must ensure that the files transferred are compliant with the Collection Encryption Suite and the SSL handshake conducted with the listening post is conducted as defined in the HTTPS standard and authenticated against a standard set of root CAs.

(S//NF) The SSL tunnel X is using to communicate with server might be subject to an SSL MitM attack, potentially using a CA issued "valid" certificate. Because X utilized the Collection Encryption Suite the take would not be compromised however this sort of interception would permit an adversary greater insight into CIA clandestine operations and facilitate more detailed traffic analysis as well as serve as a possible avenue of denial of service whereby X believes it has correctly communicated with server and therefore might not engage appropriate fallback behavior (e.g., uninstall, change beacon domain, etc.). To provide greater security against such an attack, X may go further than required and implement an inner cryptostream within the SSL tunnel transfer compliant with the Long-lived Suite. In this way X can ensure that it is delivering the raw intelligence only to a server component despite the presence of an active attacker. This makes tool X very valuable in those countries known to routinely MitM SSL (e.g., China, Iran, and other hard targets).

^{xxi} (U) RC4 has key scheduling flaws which can reveal the secret key under certain circumstances. This countermeasure makes most of those circumstances much more difficult.

Fluhrer, Mantin, and Shamir. Weaknesses in the Key Scheduling Algorithm of RC4. Proceedings of the 4th Annual Workshop on Selected Areas of Cryptography, 2001.

^{xxii} (S//NF) Note that there are two key pairs for a total of four asymmetric keys utilized in this Suite: Server_{Public} (utilized and stored on the target), Server_{Private} (utilized and stored only on classified CIA networks), Target_{Public} (utilized by server, no copy needed on the target), and Target_{Private} (utilized and stored on the target)

^{xxiii} (S//NF) One novel technique seen in the wild and provided purely as an example of a clever solution is the Random Decryption Algorithm (RDA) technique whereby a piece of malware does not possess the decryption key for its own main execution component. This malware is designed to brute force the decryption key, a process that can take several hours on modern hardware and has the added benefit of extreme resiliency to polymorphic detection heuristics and static scanning. Authors who believe they have a particularly novel approach are encouraged to contact the OCRB for a detailed discussion.